

4.11 RECREATION

Tourism related to outdoor recreation is a major sector of the Lahontan Region's economy. Recreational activities range from backpacking in wilderness areas to golfing, boating, and skiing at highly developed resorts. Water quality concerns associated with outdoor recreation include sanitation, erosion/stormwater problems (related to disturbance of soils and vegetation), and water contamination due to the use of pesticides at golf courses and fuel and paint at marinas.

Impacts of recreation are of special concern in the Lake Tahoe Basin, which receives as many as 20 million visitors annually. The application of special control measures to recreational projects on sensitive lands in the Lake Tahoe Basin is discussed in Chapter 5.

Water quality problems associated with specific recreational activities are discussed below, together with recommended regionwide control measures.

Backcountry Recreation

The Lahontan Region includes at least part of nine National Forests and ten designated wilderness areas within these forests. Wilderness recreation in the eastern Sierra Nevada is so popular that quotas for overnight use have been established for several areas. Much of the National Forest land which is not designated wilderness is managed for dispersed recreation, with few developed facilities such as parking lots, restrooms, etc. Much of the Bureau of Land Management land within the Region is also managed for dispersed recreation. Dispersed recreation can include hiking, backpacking, packing with livestock, fishing, hunting, camping at undeveloped areas, recreational use of natural hot springs, cross-country skiing, snow camping, etc. (Problems related to use of offroad vehicles are discussed in a separate section below.)

Problems related to dispersed and wilderness recreation include disposal of human and animal waste too close to surface waters, littering, destruction of meadow and riparian vegetation by trampling from humans and livestock, erosion of trails, and watershed damage by human-caused wildfires. One unusual type of problem results from the unauthorized "development" of natural hot

springs for spa use, including physical alterations to create pools, and use of disinfectant chemicals and soaps which may be harmful to unique hot spring biota.

Relatively little quantitative information is available on the baseline quality of backcountry water bodies to enable the evaluation of the extent of problems related to recreation.

Control Measures for Backcountry Recreation

Designated wilderness and national park areas are of special concern. Land use practices in these areas must assure protection of beneficial uses of water. Erosion control in the vicinity of surface waters must be implemented for all human activities which disturb the natural ground surface. Animal wastes must be managed to prevent nuisance and to protect beneficial uses of water.

Recommended Control Measures for Backcountry Recreation

1. The USFS and BLM have ongoing programs of trail maintenance and watershed restoration, including the restoration of wetlands disturbed by recreational use. Information is provided to wilderness users at trailheads regarding sanitation, etc., and wilderness rangers patrol backcountry areas to increase public awareness. These programs should be continued.
2. The USFS and BLM should conduct additional water quality monitoring to determine the impacts of dispersed recreational use. Where problems are apparent, the Regional Board should work with land managers to prevent further impacts and to ensure the implementation of remedial measures.
3. Regional Board staff should review and comment on recreation and wilderness management plans prepared by public agencies, and should encourage these agencies to mitigate water quality problems that have been identified by monitoring and/or public complaints.

Campgrounds and Day Use Areas

Developed recreation areas such as campgrounds, picnic areas, vista points, and interpretive centers generally have roads and parking lots and may have restrooms and recreational vehicle waste dumping

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facilities. They generally result in more soil disturbance and compaction, and a greater amount of impervious surface, than undeveloped recreational facilities. They are often located near surface waters, and heavy foot traffic may damage streambanks and lakeshores. Pesticides may be used at such facilities to control mosquitoes or rodent vectors of disease.

Control Measures for Campgrounds and Day Use Areas

1. The Regional Board regulates developed recreation facilities on public lands under MOUs and MAAs (see Chapter 6). It may also issue waste discharge requirements where necessary to protect water quality. Wastewater disposal at developed recreational facilities is subject to the control measures discussed in the “Wastewater” section of this Chapter, and to the regionwide septic system density limits and areawide waste discharge prohibitions where applicable.
2. New private recreation facilities involving soil disturbance of 5 acres or greater are subject to the statewide stormwater construction NPDES permit (see “Stormwater” section of this Chapter).

Recommended Control Measures for Campgrounds and Day Use Areas

1. In portions of the Region where erosion and stormwater problems threaten sensitive surface water bodies, waste discharge requirements (WDRs) should be considered for the construction of new private recreational facilities even when the statewide construction permit does not apply. WDRs may also be necessary to require installation of BMPs by existing private facilities in such areas. Waivers of WDRs may be appropriate in less sensitive areas.
2. New campgrounds and day use recreation facilities should be designed to minimize water quality impacts by avoiding disturbance of steep slopes, highly erodible soils, and riparian/wetland areas. Best Management Practices can be applied to new and existing campgrounds and day use areas to reduce erosion and provide treatment for stormwater. Control of erosion from unpaved roads and parking areas is particularly important. Interpretive displays and programs at recreational facilities should address water quality impacts of recreation and request public cooperation (e.g., use of designated fishing trails

rather than random trampling of streambank vegetation.)

3. Campgrounds and other recreational facilities on public lands are occasionally closed and remodeled or relocated to allow the recovery of compacted soils and natural vegetation. Public agencies operating developed recreational facilities which have encroached on wetlands or riparian areas should be encouraged to relocate facilities outside of these sensitive areas, and to restore riparian/wetland functions where feasible.
4. Where other disposal facilities are not locally available, public and private campgrounds which attract significant numbers of recreational vehicles should provide waste dumping stations to reduce the extent of illegal dumping.
5. Additional monitoring of the water quality impacts of developed recreation in the Region should be performed in order to facilitate the implementation of control measures, as needed.

Boating and Shorezone Recreation

Water quality problems related to boating result both from discharges of wastes from boats, and from construction and operation of facilities to support recreational and commercial boating. “Support” activities and facilities include dredging, piers, marinas, boat launching facilities, boat parking and storage facilities. (The term “boats” for purposes of this section includes river rafts, jet skis, and other watercraft.) Lake Tahoe has the greatest number of developed support facilities, including a U.S. Coast Guard station. Large commercial tour boats operate on Lake Tahoe, and there are plans for expanded “waterborne transit.” However, boating is popular at other large lakes in the Region (e.g., Arrowhead, Eagle, Crowley), and there are public and private marinas and launching facilities at many smaller lakes. There are many private piers at some lakes which are surrounded by residential development, such as Donner Lake. When flows permit, the Truckee and East Fork Carson Rivers are very popular for rafting.

Waste discharges associated with boating include human sewage, garbage and litter, fuels from leaks,

spills, and engine exhausts, and antifouling chemicals in boat paints. Boat wakes and propwash in shallow waters can also erode shorelines or suspend bottom sediment, increasing turbidity and mobilizing nutrients and contaminants in the sediment.

Almost all surface waters in the Lahontan Region are designated sources of drinking water pursuant to Proposition 65 (see "Spills, Leaks, Complaint Investigations, and Cleanups" section of this Chapter), and many of them, including Lake Tahoe, Donner Lake, and some of the Mammoth and June Lakes, have existing surface water intakes for municipal supply. (The Mammoth and June Lakes, and Crowley Lake, a very popular boating area, are part of the Los Angeles Department of Water and Power's domestic supply system.) It is thus very important to protect these domestic supplies from vessel wastes.

Dredging, whether it is done to create marinas or to maintain or increase boat access to marinas and piers under low water conditions, can have a number of potentially significant water quality impacts. It disturbs sediments, smothers bottom-dwelling organisms, and releases nutrients and contaminants which had settled out of the water. The sediments may also be redeposited elsewhere. Disposal of dredged material in the shorezone of a lake may allow leaching of dissolved nutrients and contaminants back into the lake.

The construction of piers and other shorezone structures can involve localized erosion, suspension of bottom sediments, and destruction of valuable riparian vegetation. Even after construction, piers, jetties, and marinas constitute physical alterations in natural shorezone conditions. Impermeable (e.g., rock crib) piers can alter natural patterns of sand and sediment transport along the shore, adversely affecting habitat values. Even permeable shorezone structures may have cumulative impacts on sand transport.

Many marinas are enclosed areas which trap sediment, nutrients and contaminants. Higher water temperatures within enclosed marina areas may lead to algae blooms and/or dissolved oxygen depletion. Some pollutants may accumulate in marina sediments, and affect biological processes both through gradual long-term release and through

resuspension of sediment upon dredging. Pollutants may enter marinas from boats, maintenance activities near or over water, and stormwater runoff from parking lots and other onshore impervious surfaces. In some cases, disposal of fish-cleaning wastes can increase biochemical oxygen demand (BOD). The level of pollutant accumulation in the marina depends on the level of flushing; however, flushing merely redistributes pollutants elsewhere in the lake.

Metals and metal containing compounds are widely used in boats and marina related activities. Examples include lead as ballast, arsenic in paint pigments, pesticides and wood preservatives, zinc anodes used to deter corrosion of metal hulls and engine parts, and copper and tin in antifoulant paints. Boatyard hull pressure washing operations may release metals in concentrations of environmental concern (USEPA 1993).

Elevated levels of petroleum hydrocarbons may occur in marina waters as a result of refueling activities and bilge or fuel discharges from boats. Petroleum hydrocarbons tend to adsorb to particulate matter and become incorporated into sediments. They persist for years, with long-term impacts on benthic organisms (USEPA 1993).

Shorezone structures near stream inlets to lakes can act as barriers to fish migration and/or alter currents and the transport of sediment from streams. The visual presence of large numbers of piers and shorezone structures can alter the quality of visitors' recreational experiences and thus affect recreational beneficial uses.

Beach use is popular at Lake Tahoe and at other lakes around the Region. Water quality problems associated with beach use can include sanitation, littering, and stormwater problems related to nearshore parking facilities. Because the beaches of Sierra lakes are often rocky, resorts sometimes import sand to create beaches. Lake currents may repeatedly transport the sand away from the beach, making ongoing replenishment necessary. Sand used for replenishment may contain nutrients, salts, or contaminants. Private landowners with rocky beaches may also rearrange underwater rocks offshore to create a sandy bottom for swimming and wading, with detrimental impacts on fish habitat.

Control Measures for Boating and

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Shorezone Recreation

1. *Vessel Wastes.* Direct discharges of wastes, including sewage, garbage, and litter into surface waters of the Lahontan Region are prohibited (see “Waste Discharge Prohibitions” section of this Chapter). Control of discharges of human sewage from boats is discussed in detail in the “Wastewater” section of this Chapter. Briefly, the Regional Board should determine needs for specific marinas and public launching facilities serving larger boats with holding tanks to have wastewater pumpout facilities; and should request the State Board to use its authority under the Harbors and Navigation Code to require installation of these facilities. Dumping stations for “portapotties” from smaller boats should also be readily available onshore, and floating latrines may be appropriate in some areas. Public land managers and river rafting businesses should provide restrooms or chemical toilets at heavily used raft put-in and take-out points; these facilities will be subject to regionwide onsite disposal system criteria and any local discharge prohibitions.
2. Public education programs are needed to increase use of wastewater disposal facilities and to prevent the dumping of garbage and litter from boats and rafts. Local governments should strictly enforce anti-litter laws. Voluntary beach and stream litter cleanup operations should be encouraged.
3. Most boat engines are designed for operation near sea level. These engines operate on a “rich” (very high) fuel-to-air ratio on high mountain lakes. Soot and unburned fuel can be discharged from engines not adjusted for high altitude operation. Boats based year-round at high elevations should have their engines adjusted for high altitude operation.

Regional Board staff should obtain additional information about the extent and impacts of petroleum product discharges from boat engine exhausts to surface waters of the Region. If the problem appears to be significant, the Regional Board should work with the State Board, the Department of Boating and Waterways, the Department of Fish and Game, county and state health departments, and other appropriate

agencies to develop control measures. Statewide and possibly national action, like that used to control tributyltin (TBT), may be necessary to promote or require alternative fuels and more efficient engines.

4. The use of paint containing the antifouling agent TBT on smaller boats is now prohibited by State and federal legislation. Vessels painted with TBT before January 1, 1988 may continue to be used, but may not be repainted with TBT paint. Maintenance activities on older boats need careful controls to prevent TBT paint from entering lakes in stormwater (see marina discussion below). Regional Board staff should attempt to stay aware of new information on other antifouling paint ingredients (e.g., copper) which could have significant water quality impacts.
5. Local governments, resource management agencies, and other entities with authority to regulate boating activity should exclude motorized vehicles from shallow water areas which support important habitat in order to prevent sediment and shorezone disturbance from propwash. Speed limits and “no-wake zones” can also be used for this purpose.
6. *Dredging and Underwater Construction.* The following guidelines apply primarily to dredging in connection with recreational activities. However, dredging is also performed for other purposes, such as removal of sediment from reservoirs and hydroelectric facilities. Many of the considerations below apply to these types of projects as well; see also the separate discussions of these facilities elsewhere in this Chapter.

For regulatory purposes, Regional Board staff divide dredging activities into “maintenance” and “new” dredging. Maintenance dredging involves areas and sediment depths which have been previously dredged. The depth of dredging is important to water quality because the concentrations of nutrients, organic matter, and toxic substances in sediment may vary with depth depending upon physical, chemical, and biological processes. (In Lake Tahoe, maintenance dredging may not be done below

an authorized lake bottom elevation; see Chapter 5.) New dredging is that done outside of maintenance dredging boundaries, or below any applicable approved lake bottom elevation. Waste discharge permits for marinas may include conditions for allowable ongoing maintenance dredging; new dredging generally requires a new or revised permit.

There are two major types of dredging equipment: bucket ("clamshell") dredges, and suction dredges. Bucket dredging involves the scooping and transfer of sediments to a dewatering site, and the subsequent removal of sediments to an approved disposal site. Such operations typically create highly turbid water due to bucket drag on the lake bottom as it pulls free from the sediment. Turbidity barrier installation is usually required to isolate water disturbed by mechanical dredging operations.

Suction dredges are operated like a vacuum cleaner. Sediments are removed in a slurry, which is pumped through a semi-flexible pipeline to a dewatering and/or settling area. ("Bypass" dredging may involve redeposition of sediments in another area of the lakebed.) Experience has shown that water quality impacts can be minimized if suction dredging is employed and the slurry is pumped out of the lake; in such cases, turbidity barriers may not be necessary.

Dewatering and settling areas must be designed to accommodate the expected flow and to provide necessary removal of suspended and dissolved solids. If dewatering and/or settling areas are not designed to accommodate the expected flow, temporary shutdown of dredging operations may be necessary to avoid overloading the system. Overloading the system may lead to the failure of containment berms and/or the release of water which may violate water quality standards. It is important to note that dewatering and settling areas need not be adjacent to the dredging site. Slurries can be pumped for distances of several thousand feet to several miles, depending upon particle size. In some dredging operations in Lake Tahoe, dredged sediments have been pumped from an outer channel area and discharged within a marina to be removed mechanically. In these cases, turbidity barriers are usually required to

isolate the disturbed water from the lake.

Suction dredging is often the most effective and most environmentally safe method, especially with offsite disposal. However, even with turbidity barriers, suction dredging followed by interim storage of dredged material in an "inner harbor" situation may create more problems than bucket dredging. Localized problems related to turbidity may result from repeated disturbance of stored material for final disposal. Practical limitations, such as land availability for dewatering and/or settling, may also make bucket type dredging more appropriate in some cases.

In the Lake Tahoe Basin, Regional Board staff apply the local stormwater effluent limitations to nutrient discharges from dredged material dewatering and settling areas (see "Stormwater" section of this Chapter; see also Chapter 5). In other watersheds, effluent limitations for such operations should reflect the characteristics of the slurry, and receiving water standards. In all cases, the Regional Board may require additional site-specific analysis of the material proposed to be dredged (e.g., analysis of the proportion of colloidal material or silt to sand) and may require additional mitigation as necessary.

Turbidity barriers must be designed and used with caution. Failures or breaches of turbidity barriers are usually the result of wind and current loadings which cause the barrier to pull away from its bottom anchoring. A breach in the turbidity barrier is always accompanied by a release of waters which may violate water quality standards. To avoid failures, turbidity barriers should be designed to withstand expected wind and current loadings. Care must be taken to ensure that the barrier conforms to the lake bottom, forming an adequate seal. A recommended method of bottom anchoring is to sew a heavy chain into the bottom of the barrier. It is important to realize that the weight of an object decreases when placed under water. For example, the weight of a sand bag is reduced to 1/3 when placed in water, and additional bags must be used to effectively anchor the barrier. Turbidity barriers may contribute to localized temporary water quality problems since they trap nutrients from suspended sediments, and reduced water circulation increases water

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temperature inside the barrier; both of these factors can lead to algae blooms.

Entanglements with dredging machinery are often the cause of breaches in the barrier. A ten-foot buffer zone between the barrier and machinery could prevent such occurrences.

Freeboard is the distance between the water surface and the top of the turbidity barrier. The amount of freeboard should be based on site-specific characteristics. In some cases, it may be desirable to allow some splash over the barrier, while in others it may be impossible to limit splashover without violating water quality standards. Too much freeboard can allow the barrier to act as a sail, catching the wind, which puts additional stress on the barrier and bottom anchoring. Too little freeboard could allow splashover to occur, leading to a violation of water quality standards. Fastening the tops of turbidity curtains to sections of floating piers can be very effective. In all cases, turbidity barriers should be designed with a freeboard which will limit the stress placed on the bottom anchoring and ensure that splashover discharges do not result in violation of standards.

Turbidity barriers are classified into two types, permeable and impermeable. Permeable barriers allow water and dissolved solids to pass through while stopping all but the smallest of suspended solids; impermeable barriers prevent passage of water and dissolved or suspended constituents. In dredging of an area with a high concentration of nutrients and/or toxics, and low wind and current loadings, an impermeable barrier might be more effective at isolating the nutrients and/or toxics. In cases where nutrients and/or toxics are not in high concentrations and wind and current conditions are high, permeable barriers may be preferred. Permeable barriers also have the advantage of preventing barrier failure due to excessive water pressure behind the curtain.

Site specific design is the key to successful dredging operations. The configuration of the area to be dredged, land type and availability for dewatering and or settling, types and amount of material being dredged, nutrient concentrations within the sediments, and expected weather conditions should all be considered. By tailoring

the dredging operations to the specific site, violations of water quality standards can be avoided.

Dredging and filling activities within surface waters may require a Section 401 or 404 permit from the U.S. Army Corps of Engineers (see "Wetlands" discussion in the "Resources Management and Restoration" section of this Chapter). Most lakebeds and streambeds in California are owned by the State, and their disturbance may also require a permit from the State Lands Commission and/or the Department of Fish and Game.

Proposals for dredging, filling, or dredged material disposal should continue to be evaluated on a case-by-case basis; the Regional Board should consider issuing waste discharge requirements where necessary to protect beneficial uses.

7. *Beach Creation and Replenishment.* Because it disturbs natural shorezone habitats and associated wetland/riparian values, the importation of sand to create new recreational beaches at natural lakes and reservoirs should be discouraged. Replenishment of existing sand beaches should use only clean sand.
8. *Shorezone Protection.* Eroding shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more cost-effective, considering the severity of wind and wave erosion, offshore bathymetry, and the potential adverse impacts on other shorelines and offshore areas.

The USEPA (1993) summarizes information on a variety of shoreline protection practices. General considerations include design of all shorezone structures so that they do not transfer erosion energy or otherwise cause visible loss of surrounding shorezones; establishment and enforcement of no wake zones to reduce erosion potential from boat wakes, establishment of setbacks for upland development and land disturbance, and direction of upland drainage away from bluffs and banks so as to avoid accelerating slope erosion.

9. *Piers.* Discharges attributable to the construction of new piers in certain habitat types in Lake Tahoe are prohibited (see Chapter 5). Although there are no specific pier-related prohibitions applicable to other lakes in the Region, the general discharge prohibitions discussed elsewhere in this Chapter apply to pier construction. The Regional Board has historically regulated piers serving single family homes to a lesser extent than public piers, breakwaters, jetties, marinas, and other large in-lake construction projects. Pier construction projects throughout the Region should meet the following conditions:

- The disturbance of lake bed materials should be kept to a minimum during construction. Best practicable control technology should be used to keep suspended earthen materials out of the lake. (This may involve techniques such as installation of pilings within caissons.)
- No petroleum products, construction wastes, litter or earthen materials should enter surface waters. All construction waste products should be removed from the project site and dumped at a legal point of disposal. Any mechanical equipment operating within the lake should be cleaned and maintained prior to use.
- No wood preservatives should be used on wood which will be in contact with lake water.
- The pier owner should ensure that the project contractor is aware of these and any other applicable conditions.

Regional Board staff should continue to review proposals for shorezone and underwater construction on a case-by-case basis through the Section 401 water quality certification process, and the Board should consider waste discharge requirements where necessary to protect water quality.

10. *Marinas.* Certain types of marinas in California are subject to the statewide industrial stormwater NPDES permit (see the "Stormwater Runoff, Erosion, and Sedimentation" section of this Chapter). These include marinas which are primarily in the business of renting boat slips,

storing boats, cleaning boats, and repairing boats, and which generally perform a range of other marine services (USEPA 1993). The NPDES permit applies only to point sources of stormwater from the maintenance areas at the marina. The NPDES program does not apply to marinas that are not involved in equipment cleaning or vehicle maintenance activities, or to "marine service stations" which are primarily in the business of selling fuel without vehicle maintenance or equipment cleaning operations (USEPA 1993). Marina construction or maintenance activities which do not fall under the statewide industrial stormwater NPDES permit may be subject the statewide construction stormwater NPDES permit and/or areawide municipal stormwater NPDES permits (e.g., at Lake Tahoe).

Because of the sensitivity of the affected surface waters, the Regional Board should keep individual waste discharge requirements in effect for all larger existing marinas, in order to effectively regulate the maintenance of fueling and wastewater disposal facilities, maintenance dredging, and other operation and maintenance activities which could adversely affect water quality. Proposals for new or significantly expanded marinas should be evaluated on a case-by-case basis against applicable water quality objectives, prohibitions, and effluent limitations.

Boat maintenance areas at marinas should be designed and operated to prevent the entry of toxic pollutants from marina property into surface waters. The USEPA (1993) recommends the designation of discrete impervious areas for maintenance activities, the use of roofed areas to prevent rain from contacting pollutants, and the diversion of offsite runoff away from the maintenance area for separate treatment. It also recommends source controls to collect pollutants and thus keep them out of runoff, such as sanders with vacuum attachments, the use of large vacuums to collect debris from the ground, and the use of tarps under boats which are being sanded or painted. Infiltration of runoff from non-maintenance areas is recommended; in some parts of the United States hull-cleaning waste is required to be pretreated and discharged to a sewer.

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Over-water boat maintenance activities by marina tenants should not require opening more than a pint-size paint can. Engine oil changes should not be done while a boat is in the water. The State Board's BMP handbook for industrial NPDES permits (APWA Task Force 1993) contains additional recommendations to prevent problems from over-water maintenance activities.

Liquid and solid wastes produced by marina operation, maintenance, and repair activities, including waste oils, solvents, antifreeze, and paints, should be properly disposed of. Marinas with heavy use by fishermen should also manage fish waste disposal. Fish waste management can include establishment of fish cleaning areas with waste receptacles, issuance of rules controlling or prohibiting fish cleaning at the marina, education of boaters about waste problems, and implementation of composting where appropriate (USEPA 1993).

The USEPA (1993) recommends the use of automatic shutoff nozzles, and fuel/air separators (on air vents or tank stems of inboard fuel tanks), to reduce the amount of fuel spilled into surface waters during fueling of boats. It also recommends the use of oil-absorbing materials in the bilge areas of all boats with inboard engines. These materials should be examined at least once a year and replaced as necessary.

Marina fueling stations should be designed to allow for ease in cleanup of spills. This includes allowance for booms to be deployed to surround a fuel spill. Marinas should have fuel spill contingency plans meeting local and State requirements. These plans should include health and safety procedures, notification, and spill containment and control. Appropriate containment and control materials should be stored in a clearly marked, easily accessible location. Materials should include absorbent pads and booms, fire extinguishers, a copy of the spill contingency plan, and other equipment deemed suitable. Marina tenants and employees should be educated on spill prevention and cleanup (USEPA 1993, APWA Task Force 1993).

Some marinas have chemical over-water fire

retardant systems. In reviewing marina projects, Regional Board staff should investigate the types of chemicals being used and their potential water quality impacts in relation to applicable water quality objectives.

Marina water treatment systems (to remove nutrients and turbidity) have been suggested as mitigation for the impacts of marina expansion at Lake Tahoe. The Tahoe Keys subdivision currently has a treatment system to remove phosphorus from the waters of its artificial lagoons. Any new proposals for marina water treatment systems in the Lahontan Region should be evaluated based upon site specific conditions and water quality risks associated with the proposed treatment (see discussion of lake restoration in the "Resources Management and Restoration" section of this Chapter.)

Additional monitoring should be conducted in areas of heavy boating and rafting use to document the water quality impacts of vessel wastes, shorezone construction, and dredging. In particular, marina sediments should be sampled for TBT when dredging is proposed.

Offroad Vehicles

Offroad vehicles (ORVs), (also called "off-highway" vehicles or OHVs), include, but are not limited to, any of the following: bicycles, motorcycles, "all terrain vehicles," snowmobiles, and any other vehicle (including passenger trucks and cars) operated off of paved roads. While the impacts of "mountain" bicycles are still being debated, motorized vehicles can cause serious erosion problems, directly (through soil detachment, compaction, or creation of ruts) or indirectly (through damage to vegetation or by starting wildfires). Operation of over-the-snow vehicles can also disturb soils and vegetation if there is insufficient snow cover.

Control Measures for Offroad Vehicles

1. The U.S. Forest Service and Bureau of Land Management designate ORV routes on public lands and prohibit operation away from these routes. ORV use may be further restricted during extremely dry conditions in order to prevent fires, and during wet (i.e., winter/spring) conditions when excessive soil disturbance is likely.

However, illegal use can and does occur. Compliance should be encouraged via well planned and targeted public education efforts, as well as strict enforcement of regulations.

2. Regional Board staff should continue to review and comment on proposed changes in ORV management plans of public agencies. These agencies should be encouraged to monitor the water quality impacts of legal ORV use, and to modify or close routes where water quality problems are occurring. Modifications could include rerouting of trail segments away from surface waters and wetlands, or installation of bridges at stream crossings. Closed routes should be stabilized and revegetated.
3. Some local governments have ordinances regulating ORV use, although these may be directed at problems unrelated to water quality (e.g., noise). All local governments in the Region should be encouraged to adopt and enforce ordinances which will prevent erosion from ORV use on private lands.
4. Although waste discharge requirements are generally an infeasible means of controlling the impacts of private ORV use, the Regional Board can issue requirements or cleanup orders to landowners whose property is contributing to water quality problems as a result of ORV damage. Waste discharge requirements can also be issued to commercial ORV facilities to ensure proper operation (e.g., to ensure that snowmobiles are operated over snow deep enough to prevent soil damage).

Ski Areas

Alpine skiing facilities are found on public and private lands in the San Bernardino and San Gabriel Mountains and in the Sierra Nevada, including the Mammoth Lakes, June Lakes, Lake Tahoe, and Truckee areas. Some of these ski areas have stimulated neighboring private resort development, which can include facilities such as golf courses and bike trails designed to attract summer visitors. The potential exists for the expansion of existing ski areas and the creation of new ones.

Downhill skiing facilities tend to be located at high

elevations on steep terrain with poorly developed soils, in areas receiving high amounts of precipitation. Water quality problems associated with ski areas include: erosion and sedimentation from construction and maintenance activities, disturbance of wetlands, stormwater runoff from parking lots and other impervious surfaces, and disposal of domestic wastewater in areas which are remote from urban wastewater treatment plants and which are usually unsuitable for septic systems. Snow-making and snow-grooming are also of concern. Installation of pipelines and excavation of storage ponds for snow-making can lead to severe erosion. Some ski areas use bacteria as nucleating agents for snow crystals; the bacteria can contribute nitrogen to surface runoff. Salts such as ammonium nitrate and sodium chloride may be used to groom ski slopes. Upon snowmelt, these salts may adversely affect instream uses and/or riparian vegetation.

Older ski areas were constructed with little consideration of water quality impacts. Preparation for the 1960 Winter Olympics at Squaw Valley involved channelization of a creek, filling of a wet meadow to support parking, and construction of a wastewater treatment plant which raised nitrate levels in a sole-source municipal aquifer. Later ski area developments have been more carefully planned. However, even the use of Best Management Practices (BMPs) for erosion and stormwater control cannot completely eliminate water quality impacts. The fragile soils, harsh climates, and short growing seasons at ski areas make the revegetation of cleared roads, trails, and ski slopes very difficult. Disturbed areas at most older ski resorts are still not adequately stabilized. A State Water Resources Control Board study of one ski area which used "state-of-the-art" BMPs showed an erosion rate six times higher than natural levels (White and Franks 1978).

The U.S. Forest Service uses conceptual models to evaluate the risk of Cumulative Watershed Effects (CWE) and adverse impacts on beneficial uses of water from land management activities. The methodology is primarily used to evaluate the effects of proposed timber harvest activities; however, it has recently been adapted to predict the impacts of new land disturbance during construction of skiing facilities. Chapter 20 of the U.S. Forest Service's Soil and Water Conservation Handbook (R-5 FSH 2509.22) provides a general overview of CWE

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methodology and analysis recommendations. The U.S. Forest Service's 1993 report entitled *Cumulative Watershed Effects Analysis for Heavenly Valley Ski Area* discusses the potential use of CWE procedures for ski areas in the Lake Tahoe Basin.

Analyses are performed by an interdisciplinary team, and include some degree of professional judgement. CWE analysis involves quantifying existing and proposed watershed disturbance as "Equivalent Roaded Acres" (ERA). (An acre of road is assigned an ERA of 1.0. An acre of well-vegetated ski run on a gentle slope might be assigned an ERA coefficient of 0.2; an acre of badly eroding ski run on a steep slope might be given a value of 2.0 ERA.) Disturbed areas can be analyzed after the performance of remedial erosion or drainage control work, and the ERA value can be revised downwards. CWE analysis also involves determination of a "Threshold of Concern" (TOC) for each watershed affected. The TOC is an upper limit of tolerance to disturbance (in ERA). The risk of initiating adverse cumulative water quality effects greatly increases as this upper limit is approached or exceeded. Determination of the TOC is an interactive and multi-step process which involves comparison of several watersheds with respect to the extent of land use disturbance and the occurrence or nonoccurrence of adverse cumulative impacts.

Where CWE analysis indicates that the TOC of a subwatershed in a ski area is currently exceeded or is expected to be exceeded as a result of proposed development, conditions may be placed in the ski area permits on additional new projects. These conditions can be used as a means of phasing new projects in relation to the accomplishment of remedial erosion control programs. This approach is being used by the U.S. Forest Service, Lake Tahoe Basin Management Unit and the Tahoe Regional Planning Agency for proposed ski area expansions in the Lake Tahoe Basin, and may be applied to Forest Service ski area permits elsewhere.

Control Measures for Skiing Facilities

1. The Regional Board has adopted waste discharge requirements (WDRs) and/or NPDES permits for all large ski areas in the Region, to address the problem areas identified above in relation to locally applicable water quality objectives, discharge prohibitions, and effluent limitations.

These WDRs are updated periodically to address proposed ski area expansions and/or changes in operation and maintenance activities which could affect water quality. Permit conditions include the use of temporary and permanent BMPs, the prevention and cleanup of fuel and sewage spills, and in some cases, remedial measures to correct water quality problems created by past development. Permit conditions also regulate the use of snow-making chemicals and bacteria in addition to snow-grooming chemicals.

2. The Regional Board shall review proposed new skiing facilities and issue WDRs and/or NPDES permits as appropriate.
3. Skiing facilities in the Lake Tahoe Basin shall continue to be regulated under the provisions of Chapter 5, Section 5.15 of this Basin Plan, in addition to the general control measures outlined in Chapter 4.

Recommended Control Measures for Skiing Facilities

1. The U.S. Forest Service and local governments with permitting authority over ski areas should consider placing conditions in their permits to require:
 - the effective implementation of all applicable temporary and permanent BMPs
 - measures to prevent, report, and clean up fuel and sewage spills
 - measures to limit the use of snow-making and snow-grooming chemicals where appropriate, in order to protect water quality
 - sufficient monitoring to assess water quality impacts and the effectiveness of mitigation measures
2. Land management agencies and local governments which have lead agency responsibility for permitting new or expanded ski areas outside of the Lake Tahoe Basin should encourage the preparation of comprehensive master plans and master environmental documents which recognize and mitigate the potential direct, indirect, and cumulative water

quality impacts of each new project.

3. New and expanded ski areas should be designed to minimize soil and vegetation disturbance, particularly the disturbance of wetlands. Modern techniques permit ski lift installation without road construction. Logging for clearance of ski slopes and trails can also be done by helicopter, cable, over-the-snow vehicles or other means that minimize soil disturbance. Stream crossings should be kept to a minimum. Because of the difficulty of revegetation, native herbaceous and shrubby plants should be left in place on ski slopes and trails to the greatest extent possible.
4. Local governments, land management agencies, and the Regional Board should use the Cumulative Watershed Effects (CWE) model as a means to evaluate the water quality impacts of, and the adequacy of mitigation for, development of new skiing facilities outside of the Lake Tahoe Basin. Where appropriate, CWE analyses should be prepared for existing ski areas to determine necessary remedial improvements. Where CWE analysis indicates that current or projected disturbance is in excess of the Threshold Of Concern (TOC) for subwatersheds within the ski area, further development should be permitted only in conjunction with remedial erosion control programs and monitoring plans which ensure that the ERAs within those subwatersheds are substantially reduced and driven toward or below the TOC.

Golf Courses and Other Turf Areas

For visual amenity and to provide water hazards, golf courses are often located near surface waters. Construction of golf courses may include hydrologic modification, such as diversion or damming of streams or alteration of wetlands. Golf courses involve intensive management of turf, including the use of pesticides and fertilizer which may run off into surface waters or percolate into ground water. Mowing of turf creates large volumes of clippings containing nutrients and pesticides which must be considered in decisions on disposal or composting. Golf course turf demands large amounts of water for irrigation. In some portions of the Region, reclaimed water is used to irrigate golf courses; however, as

noted elsewhere in this Chapter, the use of reclaimed water is not without a risk of water quality problems.

Other large turf areas, such as athletic fields and urban parks, can pose water quality problems similar to those created by golf courses, and should be addressed through similar control measures.

Control Measures for Golf Courses and other Turf Areas

(Control measures concerning the use of pesticides and fertilizers are discussed separately in the "Agriculture" section of this Chapter.)

1. The Regional Board has adopted waste discharge requirements (WDRs) for golf courses in the sensitive Lake Tahoe and Truckee River watersheds, and should consider issuing similar WDRs for any golf courses which have the potential to cause significant impacts on surface or ground waters. WDRs should include effective implementation of Best Management Practices, record-keeping of fertilizer and pesticide use, and monitoring of surface and/or ground water quality. Construction stormwater NPDES permits may be required for new or expanded golf courses.
2. New and remodeled golf courses should be designed to minimize the need for hydrologic modification and disturbance of wetlands and riparian vegetation.
3. New and remodeled golf courses should also be designed to require minimal fertilizer and pesticide application (e.g., through the use of target greens which require intensive maintenance on only a small portion of the course).
4. Water use for irrigation of golf courses should be minimized to the greatest extent possible. In addition to making limited water supplies available for other uses, such conservation will reduce the loading of nutrients and pesticides to surface and ground waters. New technology in irrigation systems can greatly reduce water use. Any proposed use of reclaimed water for golf course irrigation should be evaluated carefully in relation to site-specific water quality constraints.
5. In addition to irrigated turf, golf courses include buildings such as clubhouses and maintenance facilities, and parking lots, all of which may

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contribute to erosion or stormwater problems. Pretreatment of any pesticides and/or petroleum products in this stormwater may be necessary before such discharges could be permitted. Stormwater containment and treatment should be an integral part of golf course design in portions of the Region where surface waters may be affected. Although water hazard ponds may be used as stormwater retention or detention basins, eutrophication is likely to be a problem and these basins may need frequent maintenance. In desert areas of the Region, stormwater control for golf courses may be a less important consideration; however, toxic substances should be protected against the hazard of washout from flash floods.

6. Local governments should evaluate proposals for new or expanded/remodeled golf courses, or for zoning to facilitate such projects, against the water quality concerns outlined above, and should incorporate appropriate water quality mitigation measures into their conditional permits.